APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/032,567	01/02/2002	Jong-Deok Choi	YOR920010366US2	5834

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EXAMINER
PHAM, CHRYSTINE

ART UNIT	PAPER NUMBER
2122	

DATE MAILED: 12/03/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
  after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
  earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on <u>02 January 2002</u>.

2a) ☐ This action is **FINAL.**   2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) <u>1-20</u> is/are pending in the application.

     4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) <u>1-20</u> is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☒ The drawing(s) filed on <u>02 January 2002</u> is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.

     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

     a) ☐ All b) ☐ Some * c) ☐ None of:

       1. ☐ Certified copies of the priority documents have been received.

       2. ☐ Certified copies of the priority documents have been received in Application No. _____.

       3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage
application from the International Bureau (PCT Rule 17.2(a)).

     * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>02 January 2002</u>.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Remarks

Claims 1-20 are pending and presented for prosecution.

Priority

Applicant's claim for domestic priority under 35 U.S.C. 120 is acknowledged. Benefit of earlier filing date 19th April 2001 is hereby granted.

Claim Rejections - 35 USC § 112

1.   The following is a quotation of the second paragraph of 35 U.S.C. 112:

> *The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.*

2.   Claims 6, and 7 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 6 recites the limitation "the multithreaded context graphs" in line 1. There is insufficient antecedent basis for this limitation in the claim. For compact prosecution of the claims, The Office has interpreted limitation "the multithreaded context graphs" as to refer to limitation "multithreaded context graphs" recited in line 2 of claim 5. Thus, limitation "The method of claim 1" on line 1 of claim 6 has been replaced with --The method of claim 5-- in order to provide proper antecedent basis for said limitation.

Claim 7 recites the limitation "the multithreaded context graph" in line 1. There is insufficient antecedent basis for this limitation in the claim. For compact prosecution of the claims, The Office has interpreted limitation "the multithreaded context graph" as to refer to limitation "multithreaded context graph" recited in line 2 of claim 5. Thus, limitation "The method

of claim 1" on line 1 of claim 6 has been replaced with --The method of claim 5-- in order to

provide proper antecedent basis for said limitation.

Claim Rejections - 35 USC § 102

3.   The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for

the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

*(b) the invention was patented or described in a printed publication in this or a foreign country or in public
use or on sale in this country, more than one year prior to the date of application for patent in the United
States.*

4.   Claims 1-13, 17-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Mellor-Crummey

(Compile-time Support for Efficient Data Race Detection in Shared-Memory Parallel Programs,

http://portal.acm.org/citation.cfm?id=171370&dl=GUIDE&coll=GUIDE&CFID=31826656&CFTOK

EN=65552401), hereinafter, *Mellor-Crummey.*

Claim 1

Mellor-Crummey teaches **a computer processing system and a computer program product** (e.g., see page

130 left column last paragraph for *ParaScope* & associated text) **and method for statically detecting a**

datarace in a multithreaded application (e.g., see Abstract; see page 129 right column 1st paragraph for

static analysis & associated text; see page 130 left column last paragraph for *ParaScope* and *static*

program analysis & associated text; see page 132 right column first paragraph under section 3.2 for

thread of control & associated text), said method comprising:

  o **inputting a set of input information** (stored in a storage medium) **via an input interface** (e.g., see page

        130 right column 2nd paragraph under section 2 ParaScope under subsection 1 Local Analysis

        for *editors, summary information* & associated text; see page 130 right column 1st & 2nd

        paragraphs under section 2 ParaScope for *whole-program* and *procedures* & associated text);

o **a processor receiving and processing the set of input information** (e.g., see page 130 right column 1st

paragraph under section 2 ParaScope for *dependence analysis, interprocedural analyses* &

associated text); and

o **computing and outputting, via an output interface, a statement conflict set that identifies the statement pairs**

whose execution instances definitely or potentially cause dataraces (e.g., see page 132 right column 2nd

paragraph under section 3.2 Intraprocedural Strategy for *data dependence analysis,*

dependence graph, and *dependence edge* & associated text), **without executing the multithreaded**

application (e.g., see Abstract for *compile-time analysis*) .

Claim 2

The rejection of base claim 1 is incorporated. *Mellor-Crummey* further teaches wherein the

processing comprises:

o **selectively evaluating the input information** (i.e., a given pair of reference expressions) **with an**

IsPotentialDR relation (e.g., see page 129 right column 2nd paragraph 1st sentence for *two*

references); **and**

o **selectively evaluating the input information** (i.e., a given pair of reference expressions) **with an**

IsDefiniteDR relation (e.g., see page 129 right column 3rd paragraph 1st sentence for *feasible*

races).

Claim 3

The rejection of base claim 2 is incorporated. *Mellor-Crummey* further teaches **wherein, for a given**

pair of reference expressions, the IsPotentialDR relation comprises:

o **determining whether the reference expressions might be executed by different threads (negation of**

DefSameThreadObj) (e.g., see page 132 left column 1st full paragraph 3rd bullet for *access history*

declarations & associated text; see same column 1st & 2nd paragraphs under section 3.1 Basic

Strategy for *parallel construct, procedure references* & associated text);

- o **determining whether the reference expressions might access the same field of the same object** (e.g., see page 132 right column 2nd paragraph under section 3.2 Intraprocedural Strategy for *same memory location* & associated text); **and**

- o **determining whether the reference expressions might not be mutually synchronized (negation of DefSync)** (e.g., see page 131 1st paragraph under section 3 Data Race Instrumentation for *synchronization, on-the-fly monitoring* & associated text; see page 130 left column 2nd paragraph for *on-the-fly techniques, unordered conflicting accesses* & associated text).

Claim 4

The rejection of base claim 2 is incorporated. *Mellor-Crummey* further teaches **wherein, for a given pair of reference expression, the IsDefiniteDR relation comprises:**

- o **determining whether the reference expressions cannot be executed by the same thread (negation of PossSameThreadObj)** (e.g., see page 132 right column 1st paragraph under section 3.2 Intraprocedural Strategy for *thread of control* & associated text);

- o **determining whether the reference expressions must access the same field of the same object** (e.g., see page 132 right column 1st paragraph under section 3.2 Intraprocedural Strategy for *memory locations* & associated text);

- o **determining whether the reference expressions cannot be mutually synchronized (negation of PossSync)** (e.g., see page 130 left column 2nd paragraph for *on-the-fly techniques, unordered conflicting accesses, feasible races* & associated text); **and**

- o **determining whether the reference expressions must execute** (e.g., see page 130 left column last paragraph for *compile-time analysis* & associated text; see page 131 right column last paragraph 2nd bullet for *access check* & associated text).

Claim 5

The rejection of base claim 1 is incorporated. *Mellor-Crummey* further teaches **wherein the set of input information comprises a multithreaded context graph (multithreaded context graphs)** (i.e., meta-information relating to the multithreaded application) (e.g., see page 131 left column 1st paragraph under section 3 Data Race Instrumentation for *program modules, abstract syntax trees* & associated text).

Claim 6

The rejection of base claim 5 is incorporated. *Mellor-Crummey* further teaches **wherein the multithreaded context graph comprises an interprocedural call graph having each of a plurality of synchronized blocks** (i.e., synchronized methods) **as a separate node** (e.g., see page 131 left column under subsection 2 Interprocedural Propagation for *call graph* & associated text; see page 131 1st paragraph under section Data Race Instrumentation for *program modules, synchronization events, synchronization traces* & associated text).

Claim 7

The rejection of base claim 5 is incorporated. Claim recites limitations, which have been addressed in claim 6, therefore, is rejected for the same reasons as cited in claim 6.

Claim 8

The rejection of base claim 1 is incorporated. *Mellor-Crummey* further teaches **performing dynamic datarace detection on the statement conflict set** (e.g., see page 131 right column 1st paragraph under section 3 Data Race Instrumentation for *on-the-fly monitoring* & associated text).

Claim 9

The rejection of base claim 1 is incorporated. *Mellor-Crummey* further teaches **performing escape analysis to identify statements that can access memory locations accessible by more than one thread** (e.g., see page

132 right column 1st paragraph under section 3.2 Intraprocedural Strategy for *variable references* and

data race instrumentation & associated text).

Claim 10

The rejection of base claim 1 is incorporated. *Mellor-Crummey* further teaches **wherein the**

processing comprises:

- o **computing a node conflict set** (e.g., see pages 132-133 2nd paragraph under section 3.2

  Intraprocedural Strategy for *dependence graph*, *node* & associated text); **and**

- o **computing the statement conflict set by determining pairs of conflicting statements in the node conflict set**

  (e.g., see pages 132-133 2nd paragraph under section 3.2 Intraprocedural Strategy for

  dependence graph, *dependence edge* & associated text).

Claim 11

The rejection of base claim 10 is incorporated. *Mellor-Crummey* further teaches **wherein the node**

conflict set computing comprises:

- o **initializing a synchronization object set for each of a plurality of multithreaded context graph node** (e.g., see

  page 131 1st paragraph under section 3 Data Race Instrumentation for *augment Fortran ASTs*,

  adding calls & associated text).

Claim 12

The rejection of base claim 11 is incorporated. *Mellor-Crummey* further teaches **wherein the node**

conflict set computing further comprises: identifying all reachable conflicting node pairs for each thread-root node

(e.g., see page 130 left column 2nd full paragraph for *on-the-fly* & associated text; see page 132 left

column 1st paragraph 3rd bullet for *access history declarations* & associated text).

Claim 13

The rejection of base claim 12 is incorporated. *Mellor-Crummey* further teaches **wherein the node conflict set computing further comprises:**

- o **identifying all reachable conflicting node pairs for each distinct pair of thread-root nodes in the multithreaded context graph** (e.g., see pages 132-133 1st – 4th paragraphs for *dependence graph, edge, data dependence* & associated text); **and**

- o **identifying all reachable conflicting node pairs for each thread-root node in the multithreaded context graphs that is invokeable by more than one thread** (e.g., see page 132 1st paragraph under section 3.2 Intraprocedural Strategy for *variable references, thread of control* & associated text).

Claims 17-19

Claims recite limitations, which have been addressed in claims 1, 5, 8, therefore, are rejected for the same reasons as cited in claims 1, 5, 8.

Claim 20

Claim recites a computer program product comprising a computer readable medium having computer code embodied therein for performing the method addressed in claim 1, therefore, is rejected for the same reasons as cited in claim 1.

Claim Rejections - 35 USC § 103

5.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> *(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.*

6.   Claims 14-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Mellor-Crummey* in view of Flanagan et al. (US 6343371), hereinafter, *Flanagan et al.*.

Claim 14

The rejection of base claim 1 is incorporated. *Mellor-Crummey* further teaches **wherein the input**

comprises meta-information relating to a multithreaded application (see claim 5). *Mellor-Crummey* does not

expressly disclose [the application] written in an object-oriented programming language. However,

Flanagan et al. teach **a method of statically detecting data race in multithreaded application written in an object-**

oriented programming language (e.g., see Abstract; col.4:9-15). *Mellor-Crummey* and *Flanagan et al.* are

analogous art because they are both directed to a method of statically detecting data races in computer

programs. It would have been obvious to one of ordinary skill in the pertinent art at the time the

invention was made to incorporate the teaching of *Flanagan et al.* into that of *Mellor-Crummey* for the

inclusion of an object-oriented program. And the motivation for doing so would have been to support

non-finite state systems (i.e., dynamic object allocation).

Claim 15

The rejection of base claim 1 is incorporated. Claim recites limitations, which have been

addressed in claims 5 and 14, therefore, is rejected for the same reasons as cited in claims 5 and 14.

Claim 16

The rejection of base claim 15 is incorporated. *Mellor-Crummey* further teaches wherein **the input**

further comprises a plurality of bytecodes that collectively comprise the application (e.g., see page 130 left column

last paragraph for *ParaScope, run-time monitoring* & associated text).

Conclusion

7.   The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

   o   Detecting concurrency errors in multi-threaded programs, Burrows et al. (US 6009269)

   o   Method and apparatus for run-time memory access checking and memory leak detection

       of a multi-thread program, Rishi et al. (US 5953530)

      o   Software implemented method for automatically validating the correctness of parallel

computer programs, Poulsen et al. (US 6286130)

8.   Any inquiry concerning this communication or earlier communications from the examiner should

be directed to Chrystine Pham whose telephone number is 571.212.3702. The examiner can

normally be reached on Mon-Fri, 8:30am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Tuan Q Dam can be reached on 571.272.3695. The fax phone number for the

organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent

Application Information Retrieval (PAIR) system. Status information for published applications

may be obtained from either Private PAIR or Public PAIR. Status information for unpublished

applications is available through Private PAIR only. For more information about the PAIR system,

see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR

system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Chrystine Pham
Examiner
GAU 2122

November 22, 2004

WEI Y. ZHEN
PRIMARY EXAMINER